

Report Programming Class

Programming Class 24/25

Bachelor program UXD, THUAS

Student ID: 24097993

Kerr Beeldens

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Chapter 1

Introduction

This report contains my work from the programming class bootcamp. The report is split up into 7 chapters, with the first chapter (this one) being a short introduction and each of the following chapters is about 1 day of the bootcamp. These chapters are split up into a section with a summary of the topics of that day and a section that explains what the assignment was, what I tried to achieve and how you applied the topics from the “listen” segment. The final chapter is a reflection on the bootcamp as a whole. The .zip file that contains this report also contains the source code for each of the 5 assignments.



Link to GitHub

I am fully aware that no links are allowed and the .zip file is intended to stand on its own, but in case it is easier, the full contents are also available on GitHub through the following link:

https://github.com/KerrBeeldens/programming_class_24_25

A word count of this document is included in `texcount.html`.

Chapter 2

Day 1: shapes, colors & variables

2.1 Summary of topics

During this lecture the layout of the PDE was explained. A basic program to draw a line was shown. Here, it was showed that one can draw basic shapes in processing using a variety of functions. These functions have a number of parameters. These are things like numbers, strings or booleans that change the behavior of the function. Examples are:

Example 1.1

```
1 println("Hello"); // print "Hello" in the console
2 size(400, 400); // set the screen size to 400 by 400 pixels
3 point(50, 90); // draw a point at x = 50, y = 90
```

It was also explained that by using two slashes, you can create comments, which help explain code to others (like I did above). Furthermore, the coordinate system of the screen (going from left to right and from above to below) and the drawing order was shown. Colors of objects can be changed, by using:

Example 1.2

```
1 fill(255, 0, 0); // set the fill color to red
2 background(0, 255, 0); // set the background to green
3 stroke(0, 0, 255, 127); // set the stroke color to translucent blue
```

The 4 parameters representing the R, G, B and Alpha values.

Next, variables where explained. These are small pieces of data that can represent numbers, letters, words, colors booleans etc. They are created using a type specifier like `int` or `boolean` followed by a name. Naming variables is done using camelCase. One can then use this name to assign data to the variable and then use the variable like:

Example 1.3

```
1 int a = 20; // declare a variable a and assign 20 to it
2 point(a, a); // use a to place a point at 20, 20
```

Processing also has build-in variables, like `width` and `height`.

Then, some basic mathematics where shown. You can add values or variables together using `+`, subtract them using `-`, multiply using `*` and divide using `/`. It is important to keep track of the data types when doing this. It is also possible to change the datatype. For example, changing a value to an integer is possible using `int()`.

Finally the `random()` function was explained. It returns a float between 0 and the given number or when two numbers are given, between the two numbers, like this:



Example 1.4

```
1 float randomNumber = random(20); // return a random float from 0-20
2 int randomNumber = int(random(5, 20)); // return a random int from 5-19
```

2.2 Challenge description: Half-tone

The goal of the assignment was to create a static artwork which is different, yet similar every time you run the program. My goal was to create a half-tone image. Half-tones are images consisting of little dots of various sizes, traditionally used in printing. The larger the dots, the darker that part of the image appears, creating a shading effect, as can be seen in Figure 2.1.

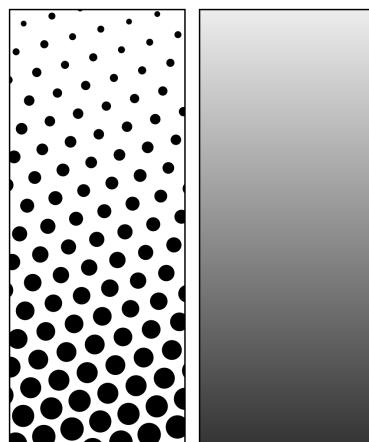
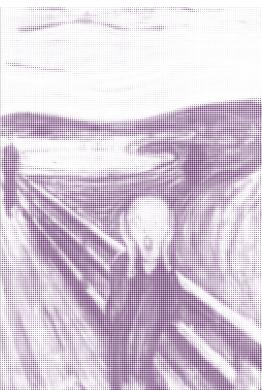
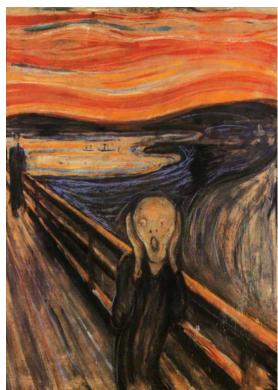


Figure 2.1: Half-tone (left) compared to the desired effect (right)

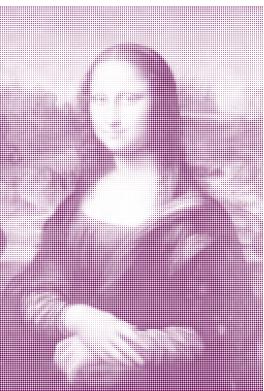
In the code, I load in multiple pieces of art and pick a random one that will be converted into a halftone. I also randomize the color of the dots using the `fill()` and `random()` functions. Throughout the program I use variables to store the image data and color values of a specific pixels in order to determine the size of the dots. I finally use the `ellipse()` function to draw the dots and achieve the effect.

The user can restart the application to get a new random image and dot color. I have included a total of 10 artworks which are displayed in Figure 2.2.



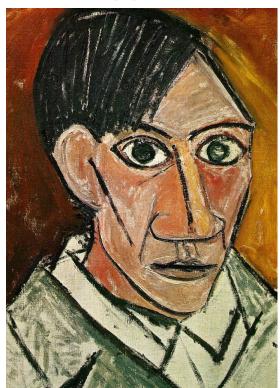
⌚ (a) Johannes Vermeer - Girl with a Pearl Earring

⌚ (b) Edvard Munch - The Scream



⌚ (c) Leonardo da Vinci - Mona Lisa

⌚ (d) Jacques David - Napoleon Crossing The Alps



⌚ (e) Pablo Picasso - Autoritratto

⌚ (f) Rembrandt van Rijn - self portrait



⌚ (g) Vincent van Gogh - self portrait

⌚ Figure 2.2: Seven famous artworks as half-tones

Chapter 3

Day 2: flow & conditionals

3.1 Summary of topics

The first topic of the lesson of today was about flow, which is the order in which the lines are executed. Yesterday's programs were executed from the top line to the bottom line, but this does not have to be the case. This can be achieved using the `setup()` and `draw()` methods. The `setup()` method is only ran once when the program launches. After that, the `draw()` method is repeatedly executed.

The second topic was about conditionals. A conditional takes the following form:



example 2.1

```
1 if (relational expression) {
2     // lines to be executed if true
3 }
```

In here the expression is a statement which can be `true` or `false`. If the statement is `true`, the lines within the conditional are executed. A relational statement takes the following form:



example 2.2

```
1 7 > 12 // > means greater than, so this is false
2 7 < 12 // < means less than, so this is true
3 7 == 12 // == means equal to, so this is false
4 7 != 12 // != means not equal to, so this is true
```

One can also combine add the `=` symbol to the less than or greater than symbols to mean less than or equal to/greater than or equal to. Next, it was also explained that with the `else` statement, you can tell the program what to do if a conditional is false:



example 2.3

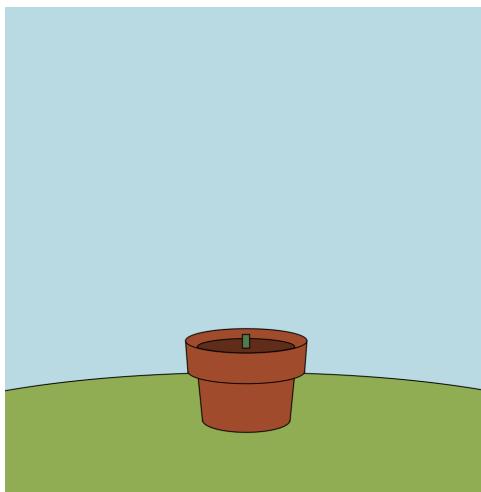
```
1 if (relational expression) {
2     // lines to be executed if true
3 } else {
4     // lines to be executed if false
5 }
```

Two unrelated topics that were briefly mentioned today were those of indentation and the mouse location. Indentation is the convention to offset lines within blocks with a tab to the right. This makes your program easier to read. The location of the mouse is stored in the variables `mouseX` and `mouseY`.

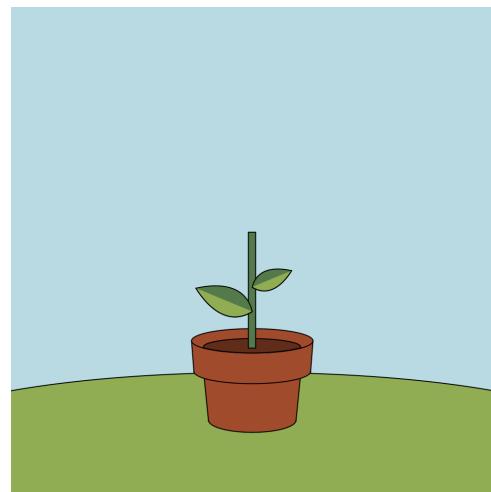
3.2 Challenge description: Growth

The goal of the challenge was to create an animation using the `setup()` and `draw()` methods. I created a short animation called *Growth*, which shows a sunflower growing. It symbolises the learning process while programming, starting from a seed and ending in a flower.

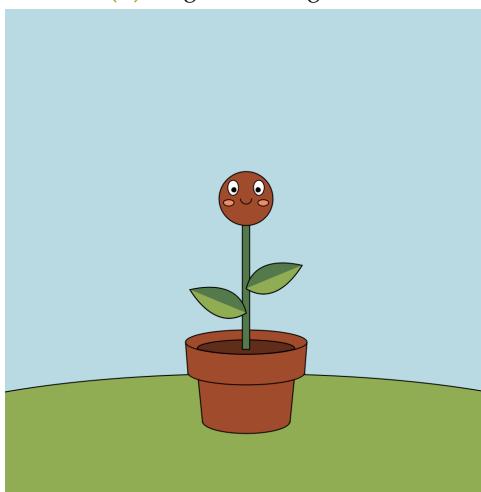
The different stages of the animation are shown in Figure 3.1. First, the stem of the flower is growing as shown in Figure 3.1a. Then, leafs start to form as the stem grows taller (Figure 3.1b). Then, the start of the sunflower is made, which has a happy face as seen in Figure 3.1c. Finally, the petals of the sunflower start to form in Figure 3.1d. After the animation has completed, the sunflower continuously waves (not shown).



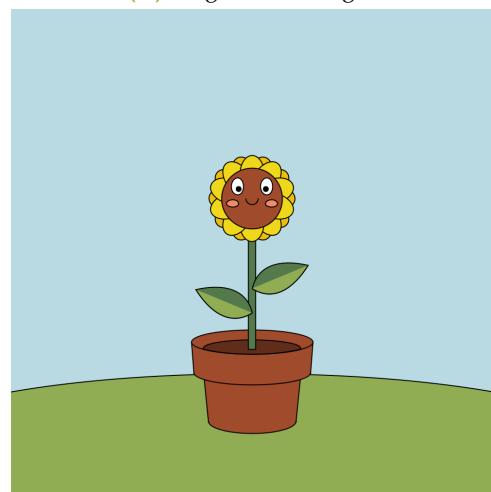
⌚ (a) Stage 1: starting the stem



⌚ (b) Stage 2: Growing leafs



⌚ (c) Stage 3: starting the flower



⌚ (d) Stage 4: Growing petals

⌚ **Figure 3.1:** Four stages of the animation

To create the animation the `setup()` method is used to set the framerate and size of the window. Then, the animation is created in the `draw()` method. If-statements are mostly used to create 'keyframes', by only starting drawing part of a flower after a certain number of frames using `frameCount`. From here, most animation use `min()` and `max()` (often together) to specify when the animation should happen and how long it should take.

Chapter 4

Day 3: conditionals & interactivity

4.1 Summary of topics

In the lesson of today we continued with conditionals. The `else` keyword was again explained, after which we also learned about the `else if` keyword. Expanding upon example 2.3 from yesterday we get:



example 3.1

```

1  if (relational expression 1) {
2      // lines to be executed if expression 1 is true
3  } else if (relation expression 2) {
4      // lines to be executed if expression 2 is true
5  } else {
6      // lines to be executed if both expression 1 and 2 are false
7 }
```

Next, logical operators where demonstrated. These allow you to combine multiple relational expression together into a single relational expression. These are as follows:



example 3.2

```

1 expr 1 && expr 2 // Expr 1 and 2 need to be true to return true
2 expr 1 || expr 2 // Expr 1 and/or 2 need to be true to return true
3 !expr 1 // Expr 1 needs to be false to return true and vice versa
```

The next topic was about user interaction. First the variables `mouseX` and `mouseY` of yesterday were explained again. Next, two methods to detect mouse button presses and key presses where demonstrated. The first method uses the `keyPressed` and `mousePressed` variables. If a key or mouse button is pressed, the respective variable returns `true`. Then, with the variables `key` and `mouseButton`, you can read out which key or button was pressed. See the code examples below.



example 3.3

```

1  if (keyPressed) { // check if a key was pressed
2      if (key == 'w') {
3          // this code is executed when the 'w' key is pressed
4      }
5 }
```

example 3.4

```

1  if (mousePressed) { // check if a mouse button was pressed
2      if (mouseButton == LEFT) {
3          // this code is executed when the left mouse button is pressed
4      }
5  }

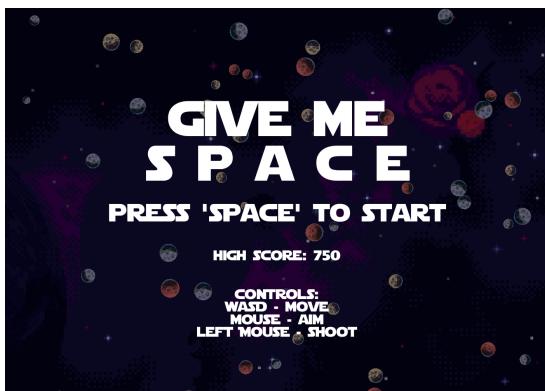
```

The disadvantage of this first method is that the program is not interrupted when the user presses a key. If the main loop of the program takes a long time, a key press might be missed. The second method uses events, which interrupt the program if the conditions for that event are met (like pressing a button). A event triggers a method which is then executed once. Examples of mouse Events are `mousePressed()`, `mouseReleased()` and `mouseMoved()`. Examples of key events are `keyPressed()` and `keyReleased()`. In all these methods you can use the variables `key` and `mouseButton` similarly to example 3.3 and 3.4 to detect which key or button was pressed.

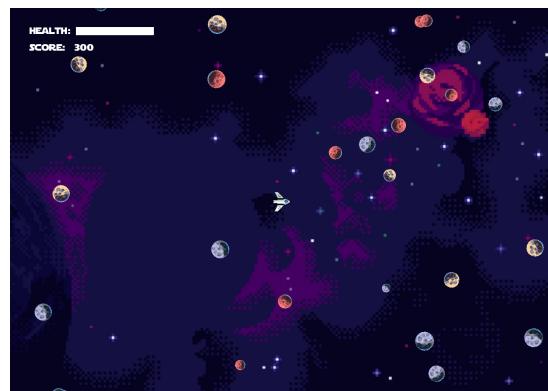
4.2 Challenge description: Give Me Space

Today's goal was to create a simple game with a clear winning and/or losing condition. I created a game called *Give Me Space*. The game is loosely inspired by arcade games like *Space Invaders* and *breakout*. The goal is to survive as long as possible, while destroying any asteroids that come on your path.

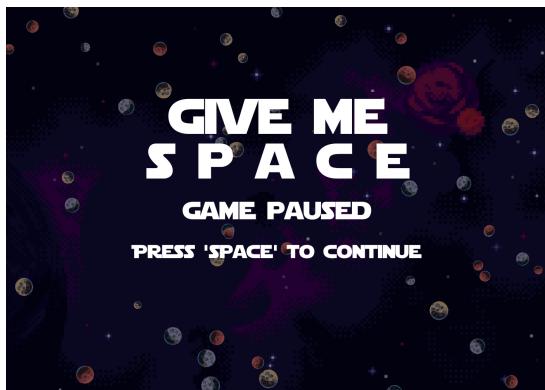
The game is shown in Section 4.2. When launching the game a start screen is shown with the current highscore. You can press space (a joke I was quite pleased with) to start the game (Figure 4.1a). The game is played using W, A and D. W moves the spaceship forward, and A and D rotate the spaceship. The mouse can be used to aim, with left click shooting a bullet. Asteroids require 1-3 bullets to be destroyed, earning 100 points. Every few seconds an extra 150 points are rewarded. When you get hit by an asteroid, you loose some health (Figure 4.1b). One can pause and unpause the game at any moment by pressing the space key (Figure 4.1c). The game is over when your health reaches 0. The score is shown and one can press the space again to go back to the main menu (Figure 4.1d).



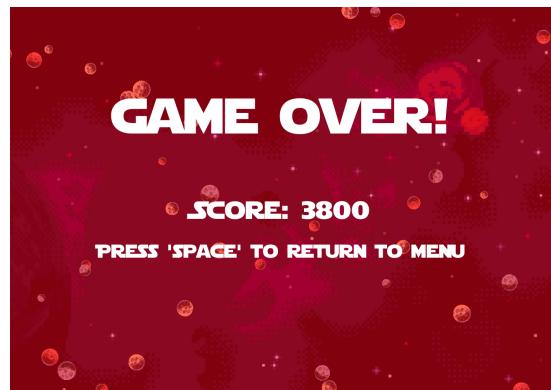
(a) Starting a new game



(b) Playing the game



⌚ (c) Pausing the game



⌚ (d) Game over

⌚ **Figure 4.1:** A typical game of Give Me Space (continued)

The game uses if-statements on plenty of occasions, like to check if the bullets or asteroids are off the screen and should be removed, or during the collision detection. User input is received using the `keyPressed()` and `mousePressed()` methods and the `key` and `mouseX/mouseY` variables. Finally, The `setup()` and `draw()` methods are used to animate the game.

Chapter 5

Day 4: loops & functions

5.1 Summary of topics

The topics for today were loops and functions. Loops make it possible to repeat a part of code multiple times, avoiding code duplication. There are two types of loops, while loops and for loops. The while loop takes on the following structure:



example 4.1

```
1 while (statement) {
2     // code that will repeat as long as the statement is true
3 }
```

The while starts by checking if the statement is `true` or `false`. If the statement is `true` the code inside the block is executed once. The statement is checked again and while it remains `true`, the code is repeated. Important to note is that if the statement is `false` to begin with, the code is never executed and if the statement is always `true`, the program will get stuck in an endless loop.

Often times a variable is used which is updated inside of the loop. Eventually this will result in the statement becoming `false`. See example 4.2. The counter starts at 0, and inside the loop is increased by 1 each time until it becomes 10 at which point the statement will be `false` and the loop stops.



example 4.1

```
1 int counter = 0;
2 while (counter < 10) {
3     counter = counter + 1 // or counter++;
4 }
```

A for loop puts all of this logic together, making it better suited for this purpose. It takes on the following structure:



example 4.3

```
1 while (init; statement; update) {
2     // code that will repeat as long as the statement is true
3 }
```

Here, the `init` statement is executed first, then the `statement` is evaluated and if the test is `true`, the code inside the block is executed. After that, the `update` is executed and the process is repeated. In example 4.4 a real example is demonstrated. This code behaves exactly the same as example 4.3.

 example 4.4

```

1 while (int counter = 0; counter < 10; counter++) {
2     // code that will repeat as long as the statement is true
3 }
```

Finally it was also demonstrated that you can use loops within each other (nested loops). This can be used to fill a grid with dots for example.

The second topic where functions. These are self-contained modules that can be seen as a factory you give an instruction. The instructions are given through parameters. Some functions can also return a value using the `return` keyword. They are useful to make code easier to read, modify and expand. Let's take a look at two types:

 example 4.5

```

1 void function(type1 parameter1, type2 parameter2) {
2     // code that uses parameter1 and 2 to do something
3 }
4
5 int function(type1 parameter1, type2 parameter2) {
6     // code that uses parameter1 and 2 to do something and return an integer
7     return integerVariable;
8 }
```

The first function takes in two parameters and uses these to do something (but return nothing). The second function does the same, but will return an integer value which can be used further in the program. Both functions can be called using `function(parameter1, parameter2)`.

5.2 Challenge description: Etch a Sketch

The assignment for today was to create an interactive image. My goal was to create a digital *Etch a Sketch*. A Etch a Sketch is a drawing toy which has two dials which can be used to move a stylus inside of the toy. The styles etches into the back of the screen which creates a drawing. Shaking the toy will remove the image so it can be used again. In Figure 5.1 the toy is shown.

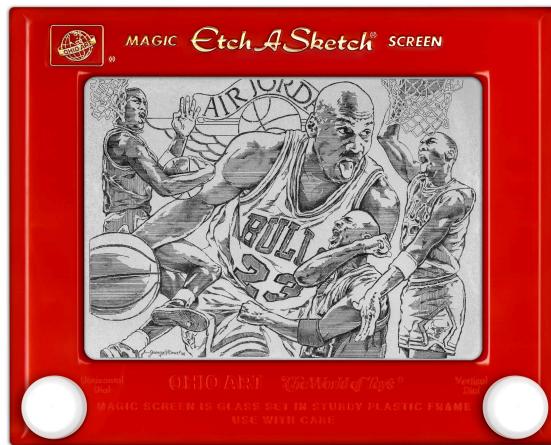


Figure 5.1: A typical Etch a Sketch

In the code, I used a nested loop in the `render()` method of the `Canvas` class in order to draw each of the squares which make up the ‘screen’ of the device. I used plenty of functions to create reusable code. In particular, the `Dial` class could be used as a generic dial in any application. Finally, I used the methods `mousePressed()` and `mouseDragged()` in order to make the dial respond to clicking and dragging the mouse.

The result is shown in Figure 5.2. Once the program is launched, you can click and hold the dial to start rotating it. By making circular motions while holding the mouse button you can rotate the dial both directions. The location of the ‘stylus’ is shown in white. The left dial controls the horizontal direction of the stylus and the right dial the vertical direction.

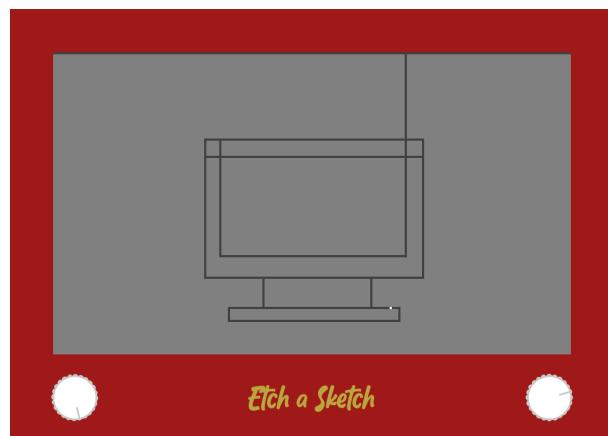


Figure 5.2: My digital Etch a Sketch

I tried to draw a computer monitor, I challenge you to do better :).

Chapter 6

Day 5: arrays

6.1 Summary of topics

The topic of today were arrays. Arrays store a set of data elements under the same name. They can store all sorts of data types, but only one at the same time. They are especially useful for storing related data together, so you don't need to create lots of separate variables. There are a few different ways to create an array

Example 5.1

```
1 int[] data; // declare
2 data = new int[5]; // initialize
3 data[0] = 10; // assign
4
5 int[] data = new int[5]; // declare, initialize
6 data[0] = 0; // assign
7
8 int[] data = {10, 5, 7, 12, 20}; // initialize, declare, assign
```

You create an array using the datatype followed by square brackets and the variable name. Then, you can either use `new datatype[n]` to create an array of size n or use curly brackets followed by a number of variables separated by commas to immediately fill the array.

You can read a write data from the array by typing its name followed by square brackets. Inside these brackets you type the index of the value you want to get. The index is the position of the data in the array, starting at 0 for the first elements. You can write to an array by using the same method as before, together with the assign operator and the (new) value you want in the array. See example 5.2

Example 5.2

```
1 int[] data = {10, 5, 7, 12, 20};
2
3 data[3] // this will give the fourth value, 12
4 data[0] = 15; // set the first value (10) to 15
```

important to note that if the index is not in the array (like -1 or in the example, 5), you get an error.

The final topic was how you can use arrays in loops. Example 5.3 was shown during the lesson.

Example 5.2

```

1 float[] grades = {6, 6.5, 9, 8.5, 5};
2 float total = 0;
3
4 for(int i = 0; i < grades.length; i++){
5     total += grades[i];
6 }
7 println(total/grades.length);

```

This code creates an array of grades and a variable `total` that will be used to store the sum of the grades. In a for loop the variable `i` starts at 0 and increases every iteration by 1. `grades.length` gets the length of the array, so the loop stops at the end of the array. Inside the loop, each value of the array is added to the `total` variable, which results in this variable being equal to the sum of the values in `grades`. Outside of the loop the average of the grades is printed.

6.2 Challenge description: Tetris

My intention for this final challenge was to create the classic game Tetris, for this I wanted to recreate in faithfully to the classic GameBoy version of the game. Just like the original, I wanted the game to randomly give the player one of the seven Tetris blocks, which slowly starts moving down the screen. The player can move the block left and right, and also rotate the block or move it down more quickly. Once the block is placed and a full row is created, the row should be removed and all the rows should shift down. Finally, the game should award points to the player and give the player a new random block. If this proved to be easy, I also wanted to recreate the look of the game, add the possibility to save a highscore and add a simple menu to the game. The original version is shown in Figure 6.1.



Figure 6.1: The original Tetris for the GameBoy

In Figure 6.2. It is shown how a typical game is played. When launching the game a start screen is shown with the current highscore. You can press the enter-key to start the game (Figure 6.2a). The game is played using the arrow keys, where the left and right keys move the block left and right. Pressing and holding the down key moves the block down more quickly. The up key rotates the pieces (Figure 6.2b). The goal is to create a full line of blocks after which that row is removed from the playing field. The number of points scored are based on the current level and the number of lines cleared at the same time. Every 5 cleared lines the level is increased to a maximum of 12. The speed of the game will increase each level. One can pause and unpause the game at any moment by pressing the enter key (Figure 6.2c). The game is over when a new block cannot be created. The score and highscore are shown and one can press the enter key again to go back to the main menu (Figure 6.2d).

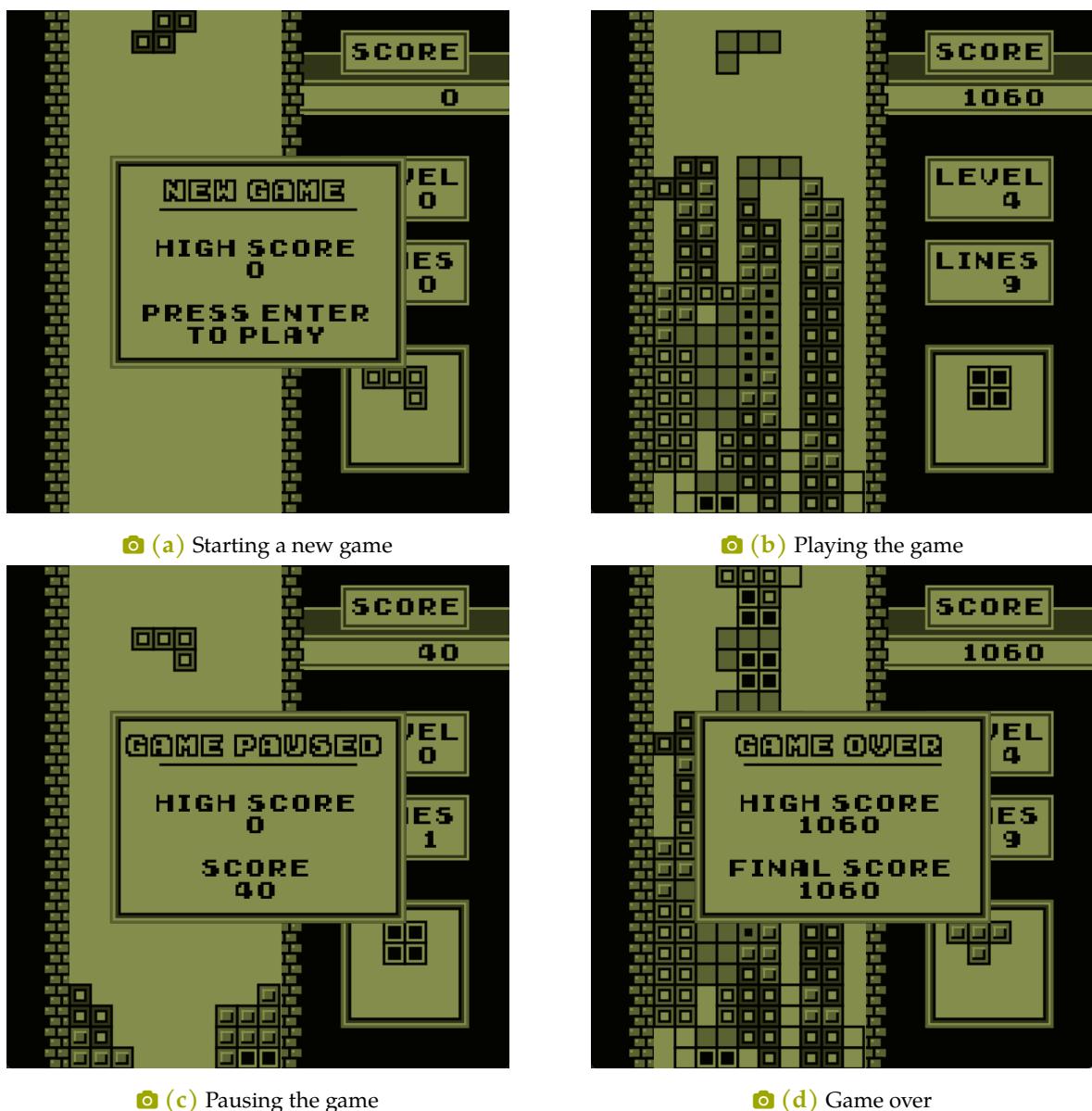


Figure 6.2: A typical game of Tetris

Chapter 7

Reflection

For starters, I follow two programs, UXD and Technical Informatics, so programming was not new to me. Hence, I did not gain a lot of new programming knowledge from the course. I am familiar with Java, but I have never used processing before. Therefore I did learn a bit about how processing worked.

What I did learn during this course was programming from a beginners perspective. Over the years that I've programmed, I learned a lot about how to approach problems in programming. Since it has been some time since I first learned programming, some of these skills have become a second nature, and it has become more difficult for me to imagine not possessing those skills. Seeing my fellow students struggle with the material made me appreciate these skills I've gained. It has also helped me understand how programming can be challenging to someone that has not yet developed these skills yet. In the future, I can use these experiences to better explain programming to non-programmers. I would also be better at communication to non-programmers in a professional setting why certain features might not be as straight forward to implement as they think.

For my career as a programmer, programming is obviously important. My other study mostly focusses on the back-end of programming, with little to no emphasis on creativity. However, I would probably want to become either a full stack developer or front-end developer, as I like to be able to express myself creatively while programming. A course like this is perfect in that regard, since it is more design oriented and creative expression through programming is its goal.

The importance of programming to UXD can in my opinion be summarized in the Venn diagram shown in Figure 7.1.

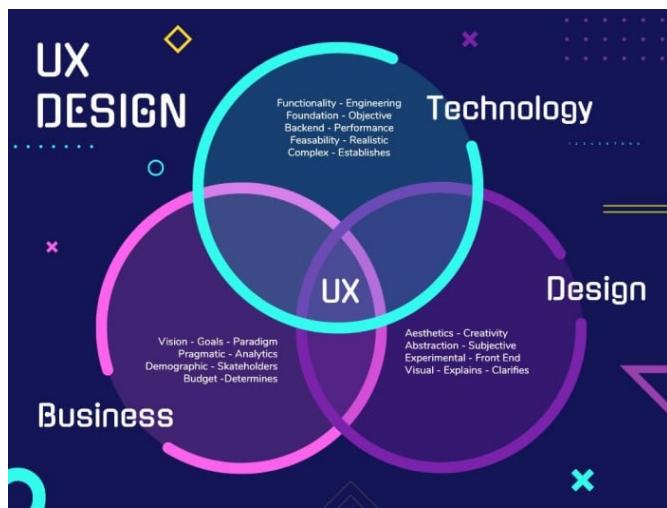


Figure 7.1: Diagram relating technology, business and design together

In the figure, UXD is shown to be the combination of design business and technology. Design was the main topic of design & creativity and Introduction to UX. Business was the main topic of Professional Skills and Research for Design. Technology was not really covered so far and I think this course is the first time this facet of UX was touched upon.